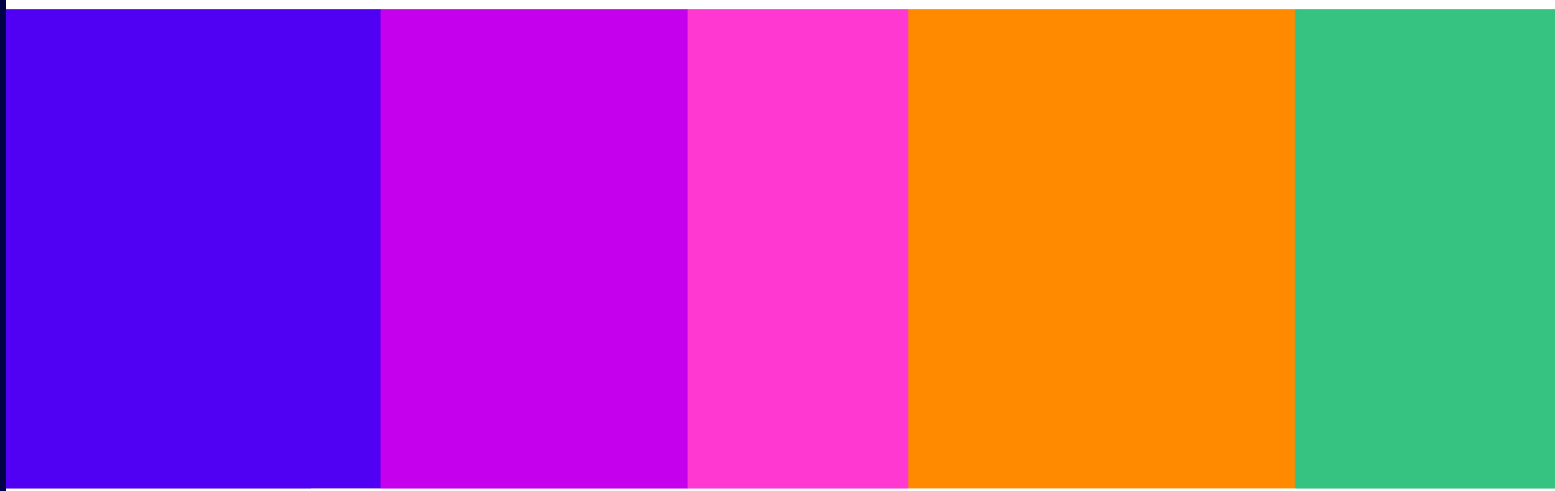


UK home broadband performance

The performance of fixed-line broadband delivered to UK residential customers

[Welsh translation available](#)

Publication date: 14 September 2023



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Overview

Ofcom's [Communications Market Report 2023](#) shows that 86% of UK households take fixed broadband. Increased homeworking, and the widespread use of bandwidth-heavy services such as video streaming, mean that most people require reliable and high-quality broadband.

This report summarises our research to understand broadband performance. It is based on two main sources of data: data collected by SamKnows from volunteers who connect a hardware monitoring unit to their broadband router; and data provided to Ofcom by the UK's four largest broadband providers.

What we have found – in brief

Service take-up

Superfast products accounted for 93% of all home broadband lines. The share of residential broadband connections that were superfast products (those with an advertised speed of 30 Mbit/s or higher) increased from 91% to 93% in the year to March 2023, while 11% of lines were ultrafast products with advertised speeds of at least 300 Mbit/s.

Connection speeds

Average residential download speeds have continued to increase. The median average download speed of UK home broadband connections was 69.4 Mbit/s in March 2023, a 10.1 Mbit/s (17%) increase year-on-year, as people upgraded to higher-bandwidth services.

Three per cent of lines had an average 24-hour actual download speed of less than 10 Mbit/s in 2023, down from 4% in 2022. This is the minimum download speed required for a decent broadband connection. Less than 1% of lines had an advertised download speed under 10 Mbit/s.

The gap between average urban and rural speeds has narrowed. There was a 26% difference between average urban (70.3 Mbit/s) and rural (56.0 Mbit/s) download speeds during the 8-10pm peak-time period, down from 58% in 2022.

There was a large increase in median average upload speeds, rising to 18.4 Mbit/s in March 2023. This was a year-on-year increase of 7.8 Mbit/s (73%).

Many ADSL2+ users will experience a considerable performance improvement if they upgrade to FTTC. Average download speeds for basic (36-38 Mbit/s) FTTC services were around three times those of ADSL2+ services, while upload speeds were more than eight times those of ADSL2+.

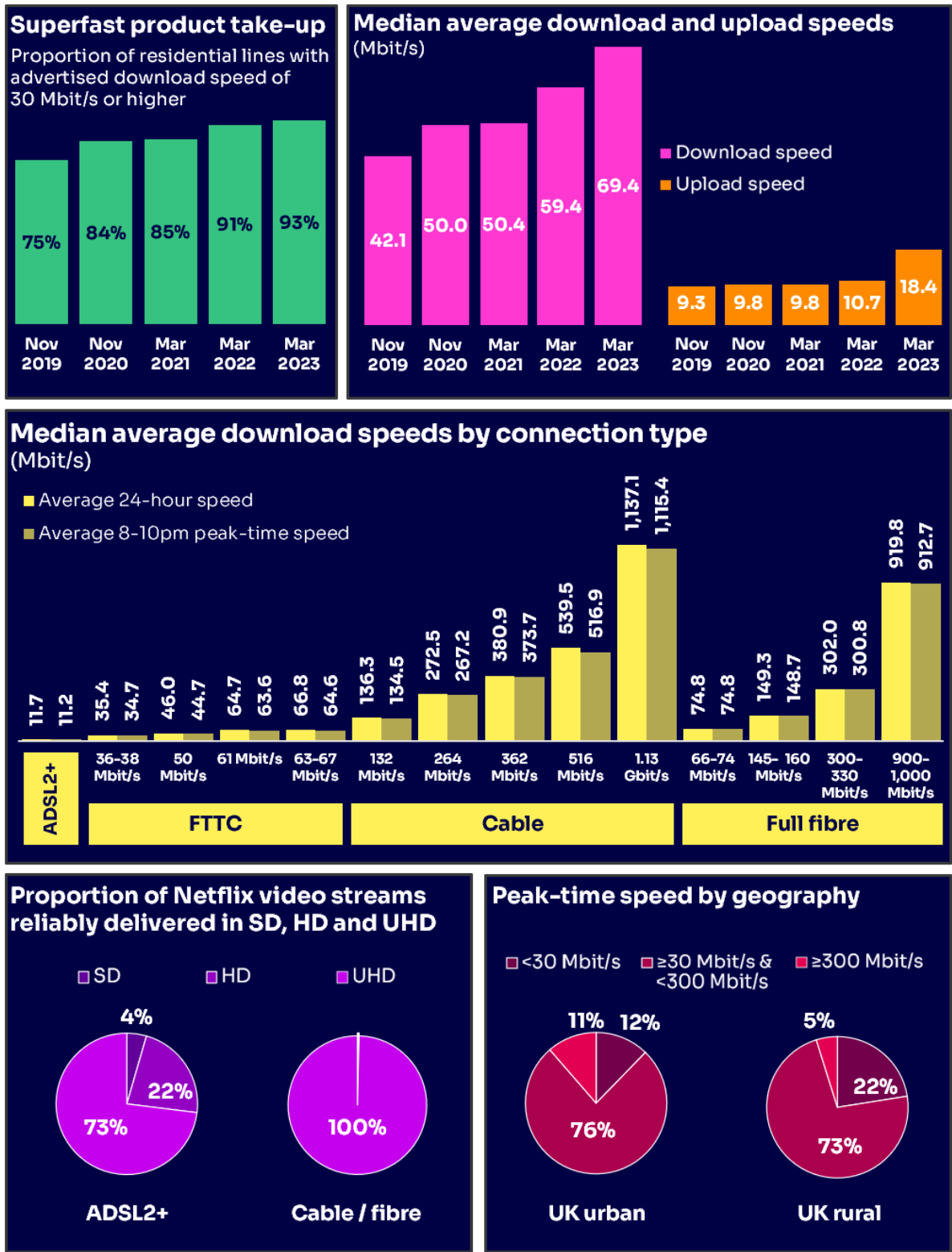
Cable and full-fibre services recorded the highest average speeds. The fastest median average 24-hour download speed was recorded by Virgin Media's 1.13 Gbit/s cable package (1,137 Mbit/s), while Gigaclear's 300 Mbit/s full-fibre service had the highest average upload speed (337 Mbit/s).

Performance varies by package and technology, but broadband services using the same wholesale input tend to perform similarly. While people can achieve improved performance through switching technology or speed tier, we found few differences between comparable services offered by providers such as BT, EE, Plusnet, Sky and TalkTalk, which use the same Openreach wholesale inputs.

Network slowdown

Across all connections, 8-10pm peak-time download speeds averaged 95% of maximum speeds. ADSL2+ connections suffered the highest proportional slowdown during busy periods, with peak-time download speeds averaging 92% of average maximum speeds in March 2023.

Dashboard



Notes on the data included in this report

Our methodology measures the performance delivered by an internet service provider to the customer's router.

However, the connection experienced on devices in the home's connection will vary, as it is impacted by additional factors not captured in our research. These include Wi-Fi performance, the quality of any in-home wiring, in-home congestion when a number of devices are using the broadband connection, device limitations and the performance of servers delivering content over the connection. We have published advice on our website on [how broadband users can improve their Wi-Fi experience](#), along with a [broadband availability checker](#).

Further analysis of results from our March 2023 testing, including broadband provider package comparisons covering other aspects of broadband performance that help determine the overall user-experience, can be found in the [interactive dashboard](#) that accompanies this report.

There are other ways to measure the performance of broadband connections. Our [Connected Nations reports](#) include analysis of broadband speeds based on information on the 'sync speed' or 'configured speed' of active broadband lines, which is provided to Ofcom by broadband providers. This approach measures the maximum achievable connection speed between the broadband provider's access network and the customer's premises, which is not affected by network slowdown and is usually higher than the 'end-to-end' actual line speed measurements we present here.

This is Ofcom's last planned Home Broadband Performance report. We continue to believe there is value in making information regarding the performance of UK broadband connections available to consumers and stakeholders, and we are exploring the use of alternative data sources to do this.

Embedded panel tests

One limitation of our hardware-based measurement methodology is that we can only include a broadband package when we have enough volunteer panellists using it, and so it can be difficult to include packages with lower take-up, including those using newer technologies such as full fibre. To try to address this, we requested 'embedded' data from the UK's four biggest broadband providers and this report includes analysis of this information.

BT and Virgin Media have SamKnows test firmware embedded into some of their customers' routers, and Sky and TalkTalk have similar tests provided by ASSIA Inc. in some of their routers. These broadband providers have given Ofcom access to anonymised March 2023 test data for upload speeds, download speeds and latency from a selection of these customers.

Ofcom benchmarking has confirmed that running the tests on a broadband provider's router rather than on one of SamKnows' 'Whitebox' measurement units has little influence on the recorded measurements. However, there are some differences which mean that like-for-like comparison is not always possible, and we have noted where we have used 'embedded' test data captured by broadband providers' routers.

Most SamKnows Whitebox measurement units are connected to the panellist's broadband router using Gigabit Ethernet. Gigabit Ethernet can transmit data at a speed of 1 Gbit/s but packet overheads mean that the maximum speed at which data can be transferred over a Gigabit Ethernet interface is approximately 940 Mbit/s. This limits the maximum connection speed that can be accurately measured over Gigabit Ethernet to around 940 Mbit/s. Due to this limitation, we have been unable to include download speed data captured by SamKnows' Whiteboxes relating to 1.13

Gbit/s cable services in this report and have instead used embedded test data provided to Ofcom by Virgin Media.

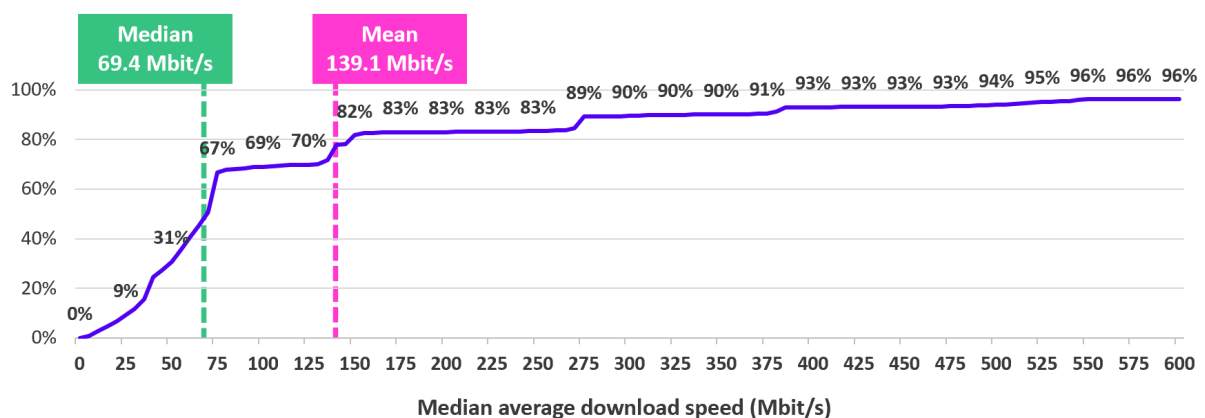
Mean and median averages

We focus on median averages (the middle value when a dataset is ordered from lowest to highest) rather than mean averages (calculated by adding all values in a dataset and then dividing by the number of values in that set) in our reports when analysing connection performance. However, the [interactive dashboard](#) that accompanies this report shows median and mean averages where available (and appropriate).

Median averages more accurately reflect the experience of consumers, as average performance is not distorted by a comparatively small number of very fast, or very slow, connections. This approach is in line with the Advertising Standards Authority (ASA) and the Committee of Advertising Practice (CAP)'s [guidance on broadband speed claims](#) and provides information that is more easily comparable to the speed claims that broadband providers make in their advertising.

Figure 1 below shows the cumulative distribution of average 24-hour download speeds in March 2023. The median average actual download speed (69.4 Mbit/s) is less than half the mean average speed (139.1 Mbit/s), as the mean is affected by a small share of lines with extremely high download speeds. We expect that the difference between the median and mean averages will continue to widen until the point when less than half of home broadband connections are provided using copper-based technologies, at which point it will start to narrow.

Figure 1: Cumulative distribution of download speeds: March 2023



Source: Ofcom, using data provided by SamKnows

Download speeds

Introduction

Download speeds are important as they determine the time it takes for information to be delivered to a user's device. Higher download speeds make a particular difference when downloading large files, such as games, films, or apps, or when streaming high-resolution video content. In this section we look at average UK download speeds and differences in download speeds between urban and rural areas of the UK.

Median average download speeds increased by 10.1 Mbit/s since 2022

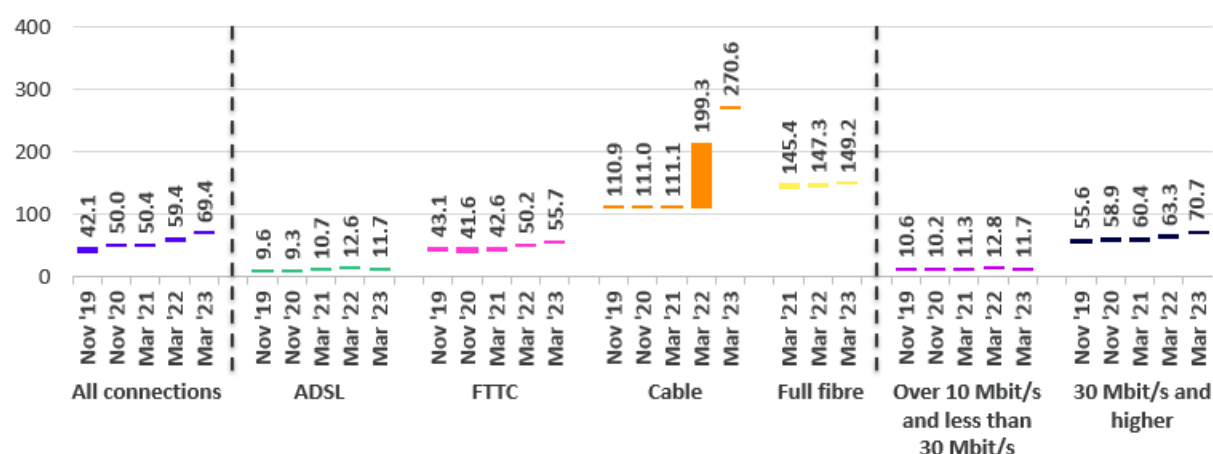
The median average 24-hour actual download speed recorded across UK residential fixed broadband connections was 69.4 Mbit/s in March 2023, a 10.1 Mbit/s (17%) increase compared to March 2022. This was mainly driven by people upgrading to superfast, ultrafast and gigabit broadband services, rather than improvements in the performance of individual broadband packages. According to Ofcom's [Connected Nations update: Summer 2023](#), 75% of UK homes had availability of gigabit-capable broadband networks by May 2023, including 52% of homes where full-fibre services were available.

Cable connections had the biggest increase in their median average download speed across technologies in the year to March 2023, rising by 71.3 Mbit/s (36%) to 270.6 Mbit/s. While considerable, this was lower than the 88.1 Mbit/s (79%) increase recorded in 2022.

The average download speed delivered by fibre-to-the-cabinet (FTTC) connections increased by 5.6 Mbit/s (11%) year-on-year to 55.7 Mbit/s. This was partly because of growth in take-up of G.fast services, which can offer advertised connection speeds that are more than double those of the very high-speed digital subscriber line (VDSL) technology used for most FTTC connections. Full-fibre connections recorded a median average download speed of 149.2 Mbit/s, an increase of 1.9 Mbit/s (1%) during the year. Asymmetric digital subscriber line (ADSL) standard broadband connections had the lowest average download speeds across all the technologies (11.7 Mbit/s) and average download speeds for these services fell by 0.8 Mbit/s (7%) in the year to March 2023.

The average download speed of standard broadband products with an advertised speed greater than 10 Mbit/s and less than 30 Mbit/s decreased by 1.1 Mbit/s (9%) to 11.7 Mbit/s in the year to March 2023. Conversely, average download speeds for superfast, ultrafast and gigabit broadband products (those packages with an advertised speed of at least 30 Mbit/s) increased year-on-year, up by 7.4 Mbit/s (12%) to 70.7 Mbit/s.

Figure 2: Median average actual broadband download speeds: 2019 to 2023 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [A] in the [Sources Annex](#).

Notes: The chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists within our sample) falls within the ranges shown; data labels show the median average values; ADSL comprises ADSL1 and ADSL2+.

Ninety-three per cent of residential broadband lines were superfast products in March 2023

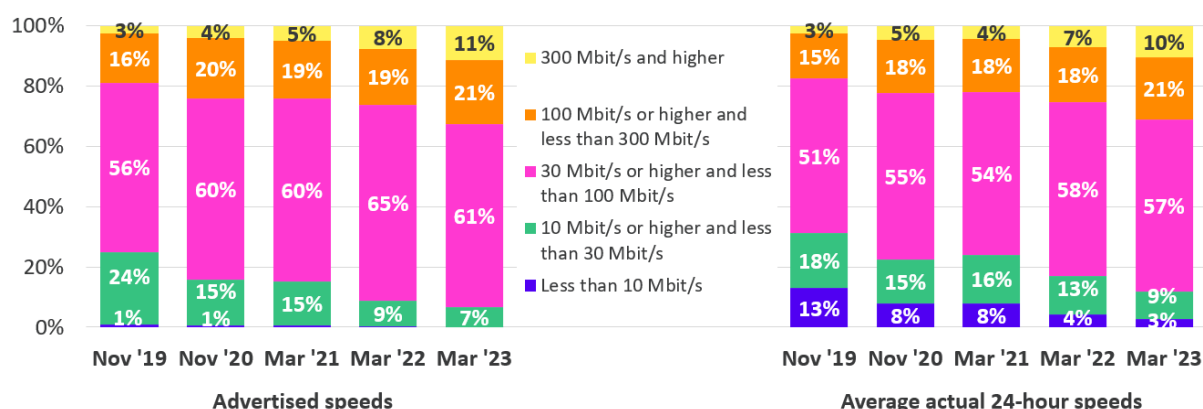
The proportion of home broadband lines that were superfast products (those with an advertised download speed of at least 30 Mbit/s) increased from 91% to 93% in the year to March 2023. The share of lines with an advertised download speed of 100 Mbit/s or higher also increased year on year from 26% to 33%, while the share of lines with advertised download speeds greater than 300 Mbit/s increased by four percentage points (pp) to 11%. This indicates that UK home broadband users are continuing to upgrade to faster connections.

The increasing take-up of faster advertised broadband services is demonstrated by an increase in the actual download speeds delivered. The proportion of lines receiving a 24-hour average download speed of at least 30 Mbit/s was 88% in March 2023, up from 83% in March 2022, while the proportion receiving an average actual 24-hour download speed of at least 300 Mbit/s increased by 3pp to 10%.

Three per cent of lines had an average 24-hour actual speed less than 10 Mbit/s, the minimum download speed of a decent broadband connection, as defined by the Government for the [broadband universal service obligation](#). However, less than 1% of lines had an advertised speed of less than 10 Mbit/s.

Most lines experiencing actual download speeds of less than 10 Mbit/s will be ADSL connections experiencing poor performance. Since March 2020, people who cannot receive a broadband connection with a download speed of 10 Mbit/s and an upload speed of 1 Mbit/s have had the right to request an upgraded connection under the [broadband universal service obligation](#).

Figure 3: Distribution of UK residential broadband lines, by advertised and 24-hour average actual speeds: 2019 to 2023



Source: Ofcom / operators and Ofcom, using data provided by SamKnows; see note [B] in the [Sources Annex](#).

Average rural ADSL2+ download speeds are less than half those in urban areas

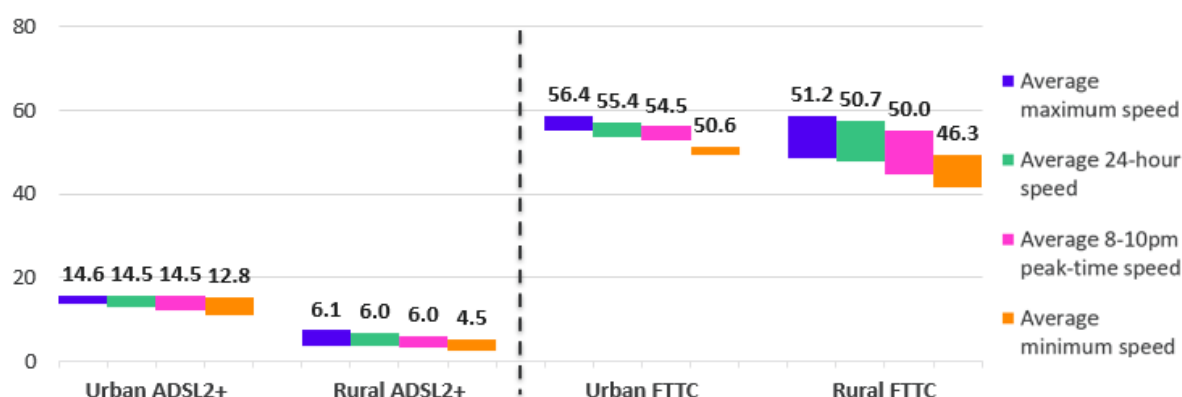
One feature of the technologies used to deliver ADSL and FTTC broadband is that connection speeds slow due to signal loss (attenuation) in the copper over which data travels.

ADSL broadband is delivered over copper all the way from the local telephone exchange to the user's premises, meaning the actual broadband speeds the user receives depends on how far away their premises is from the local telephone exchange. Urban ADSL lines tend to be shorter than those in rural areas (due to greater population density) and urban ADSL lines therefore tend to perform better than those in rural areas. Unlike ADSL, FTTC broadband is delivered using fibre optic cables from the local telephone exchange to the street cabinet, with copper being used to the user's premises from there. This means there is generally a smaller variation in the length of copper line used to deliver FTTC compared to ADSL and therefore a smaller difference in performance for FTTC relative to ADSL connections.

Our data shows that the median average 24-hour download speed for ADSL2+ connections (which make up almost all ADSL lines) in urban areas was 14.5 Mbit/s in March 2023, more than double the 6.0 Mbit/s average in rural areas. Median average urban and rural 24-hour FTTC download speeds were 55.4 Mbit/s and 50.7 Mbit/s respectively in March 2023, however, there were no statistically significant differences between these speeds, or between the average urban and rural FTTC download speeds in any of the time periods that we looked at.

Average rural FTTC download speeds in March 2023 were over eight times faster than average rural ADSL2+ download speeds, suggesting that most rural ADSL users who migrate to an FTTC service will receive a significantly improved user experience.

Figure 4: Median average ADSL2+ and FTTC download speeds, by rurality: March 2023 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [C] in the [Sources Annex](#).

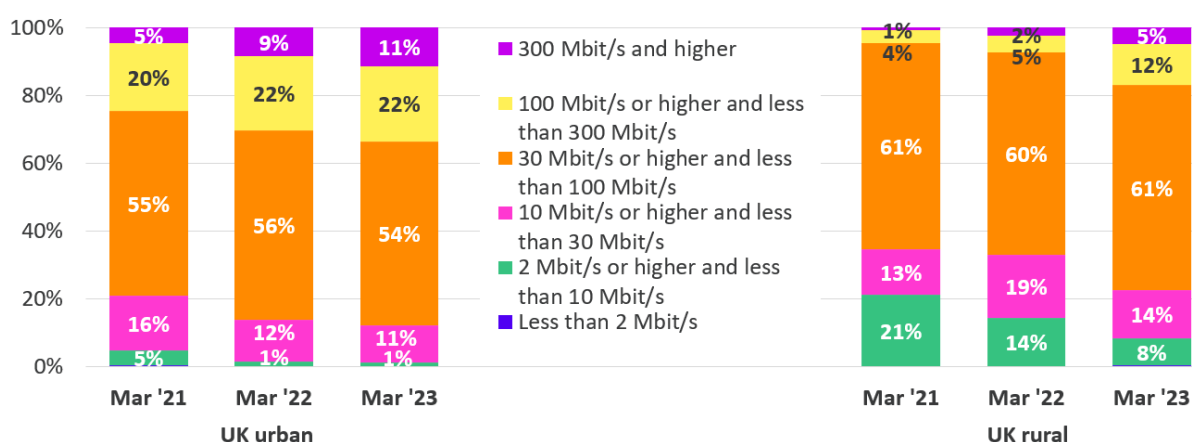
Notes: The chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists within our sample) falls within the ranges shown; data labels show the median average values

The gap between rural and urban download speeds has narrowed

In March 2023 there was a 14.3 Mbit/s (26%) difference between the median average peak-time download speeds in urban (70.3 Mbit/s) and rural (56.0 Mbit/s) areas of the UK. This was less than the 22.7 Mbit/s (58% difference) in March 2022.

There was a 10pp difference between the proportion of urban (88%) and rural (78%) lines with an average evening peak-time speed of 30 Mbit/s or higher in March 2023. This was lower than the 19pp difference found in March 2022. The 7pp difference between the March 2023 proportions of urban (1%) and rural (8%) lines with an average 8-10pm peak-time actual download speed of less than 10 Mbit/s was also considerably lower than the 13pp difference recorded in March 2022.

Figure 5: Distribution of average 8-10pm peak-time home broadband download speeds, by rurality: 2021 to 2023



Source: Ofcom, using data provided by SamKnows; see note [D] in the [Sources Annex](#).

Download speeds: network slowdown

Introduction

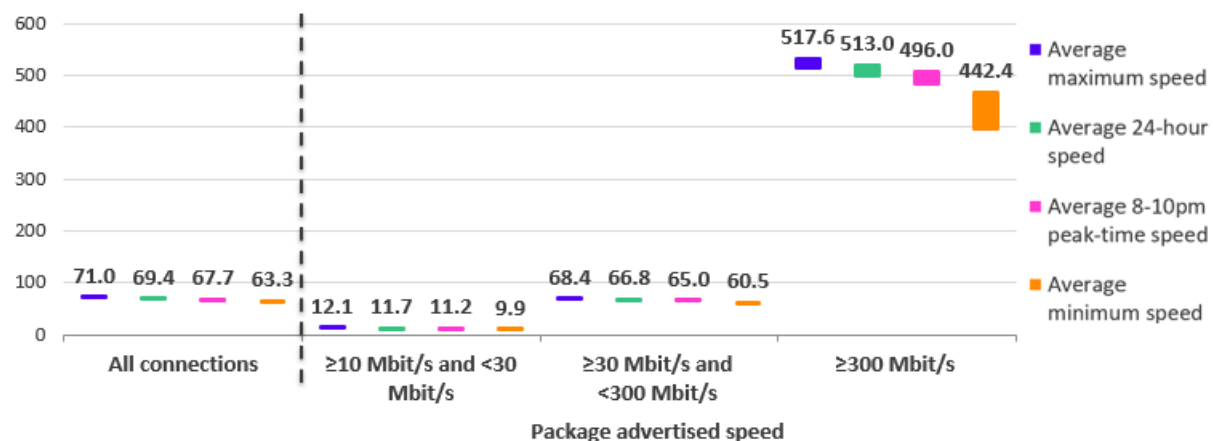
Average download speeds can slow when broadband networks are busy. This is known as network congestion or contention. In this section we consider how network congestion affects download speeds throughout the day.

Download speeds slow at peak time due to network congestion

Across all connections, the average 8-10pm peak-time download speed (67.7 Mbit/s) was 95% of the 71.0 Mbit/s average maximum speed, up from 94% in March 2022. Similarly, the average daily minimum speed (63.3 Mbit/s) was 89% of the average maximum speed, up from 87% in March 2022.

Network slowdown was more apparent in the recorded speeds of slower connections than in the recorded speeds of faster ones. Our research shows that lines with an advertised download speed of above 10 Mbit/s and less than 30 Mbit/s (which are mainly ADSL2+ lines) had average peak-time speeds that were 92% of average maximum speeds. This compared to 95% for lines with advertised speeds of 30 Mbit/s or higher but less than 300 Mbit/s and 96% for ultrafast products with an advertised speed of 300 Mbit/s or more.

Figure 6: Median average UK broadband download speeds, by time of day: March 2023 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [A] in the [Sources Annex](#).

The effect of network congestion during busy periods is lowest for full-fibre lines

Home broadband connections do not always provide their maximum or advertised speed for two main reasons:

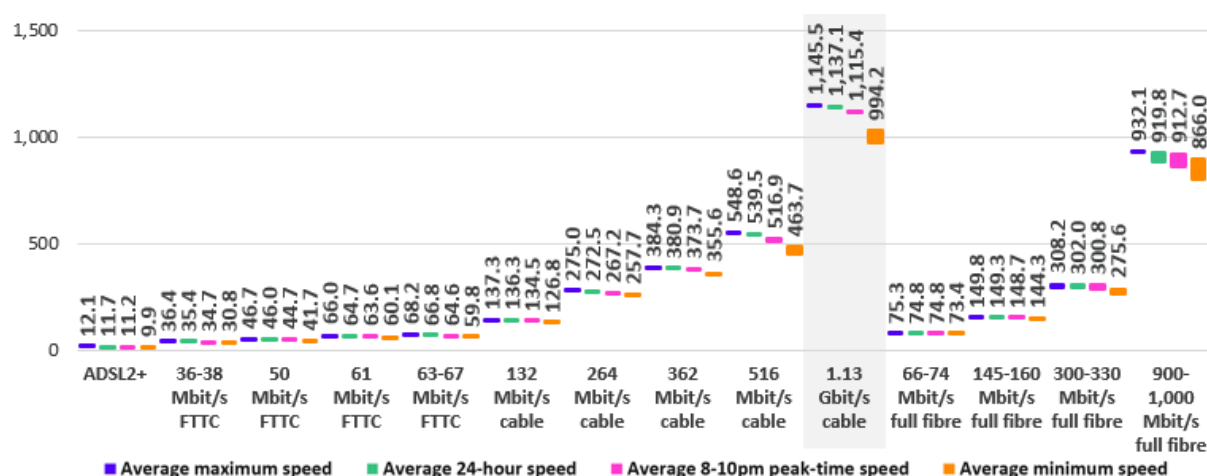
- Actual speeds tend to slow for all connection types when broadband providers' networks are busy. The variation in speeds at peak-time (8-10pm) is often higher in cable connections due to network congestion occurring nearer to the customer, making it harder for cable operators to add the additional network capacity required to reduce the effects of congestion.

- For copper-based technologies such as ADSL, VDSL and G.fast, the maximum speed that a line can support is dependent on the length and quality of the copper line from the end-user's home to the local exchange (for ADSL) or street cabinet (for VDSL and G.fast). Speeds can also be influenced by interference issues and due to these factors, the lines to some premises will never support the service's advertised speed. However, under Ofcom's [Residential Voluntary Code of Practice on Better Broadband Speeds](#), broadband providers signed up to the code must provide an estimate of the speed that the line can support before purchase.

Median average peak-time download speeds averaged between 94.7% and 96.3% of average maximum download speeds for 36-38 Mbit/s, 50 Mbit/s, 61 Mbit/s and 63-67 Mbit/s FTTC services in March 2023. Among 132 Mbit/s, 264 Mbit/s, 362 Mbit/s, 516 Mbit/s and 1.13 Gbit/s cable services, average 8-10pm peak-time download speeds were between 94.2% and 97.9% of maximum speeds.

For 66-74 Mbit/s, 145-160 Mbit/s, 300-330 Mbit/s and 900-1,000 Mbit/s full fibre broadband services, average 8-10pm peak-time speeds ranged between 97.6% and 99.3% of their average maximum download speeds. Peak-time download speeds averaged 92.0% of maximum speeds for ADSL2+ lines.

Figure 7: Variations in download speeds, by time of day: March 2023 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [E] in the [Sources Annex](#).

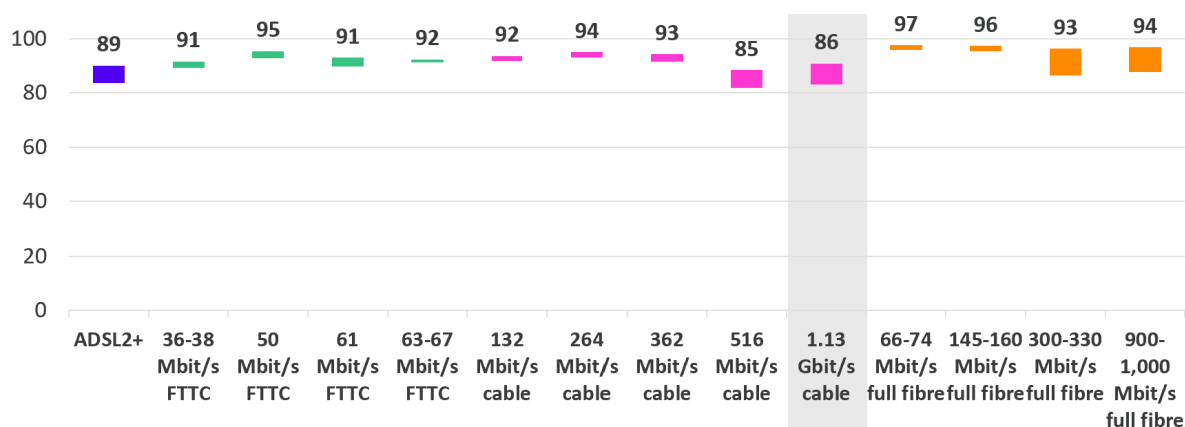
Note: Data for 1.13 Gbit/s cable connections is taken from embedded test data, as outlined on page 5 of this report. While these measurements are valid, caution should be taken when comparing the performance of these connections to those of other package types.

Figure 8 below gives an indication of how speeds may typically slow down on an individual line in peak periods. Unlike Figure 7 above, the values below are calculated as the median average of the ratios of minimum over maximum speeds for each individual panellist in a package category.¹ The median average minimum speed was over 85% of their respective average maximum speed for all line types included in our analysis. Full-fibre services with an advertised speed of 66-74 Mbit/s had

¹ The data shown in Figure 8 are not comparable to those that would be derived from Figure 7 above. The values in Figure 7 show the median average minimum speed for each connection type as a proportion of the median average maximum speed for that connection type. This represents the variation in performance across the package category overall, but does not necessarily show the difference between minimum and maximum speeds that an individual line can expect to achieve.

the highest median average minimum speed as a proportion of their average maximum speed across the line types included in our analysis, at 97%.

Figure 8: Median minimum speed as proportion of maximum: March 2023 (%)



Source: Ofcom, using data provided by SamKnows; see note [F] in the [Sources Annex](#).

Notes: We use the advertised speed in this calculation where the average maximum speed is higher than the advertised speed to ensure that performance above what the customer might expect does not result in a package type appearing to perform less well in this analysis. The chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists in our sample) will fall within the ranges shown; data labels show the median average values; data for 1.13 Gbit/s cable connections is taken from embedded test data, as outlined on page 5 of this report. While these measurements are valid, caution should be taken when comparing the performance of these connections to those of other package types.

Upload speeds

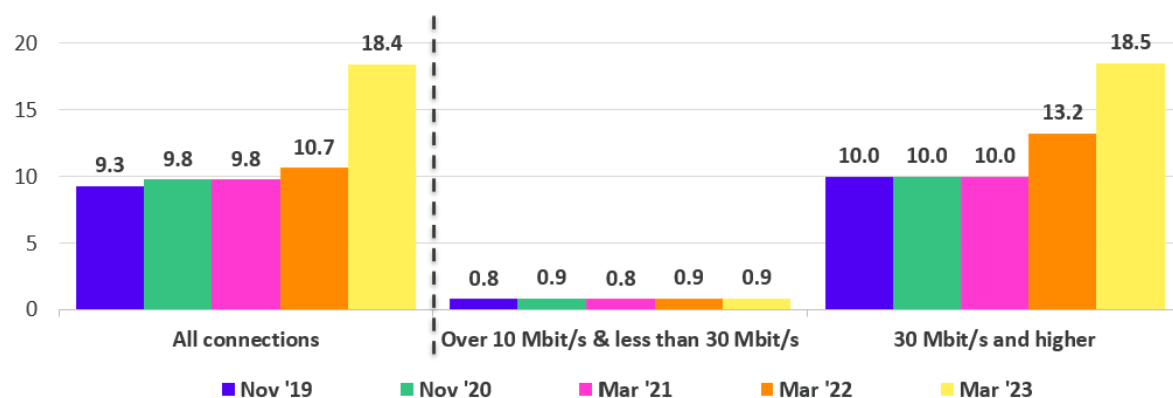
Introduction

Upload speeds are important for real-time video communication services, online gaming and uploading or sharing files.

There has been a steep increase in median average upload speeds

The median average upload speed of UK residential home broadband services increased by 7.8 Mbit/s (73%) to 18.4 Mbit/s in the 12 months to March 2023. This was driven by increasing take-up of services with higher advertised download speeds, which typically also offer higher upload speeds.

Figure 9: Median average UK fixed broadband upload speeds (Mbit/s): 2019 to 2023



Source: Ofcom, using data provided by SamKnows; see note [G] in the [Sources Annex](#).

Netflix streaming and disconnections

Introduction

Streaming video content requires a reliable connection, and higher broadband speeds allow for a better user-experience with less buffering and playback problems when streaming high-resolution video content. Disconnections can be inconvenient as users cannot undertake online activities when their internet service loses connection.

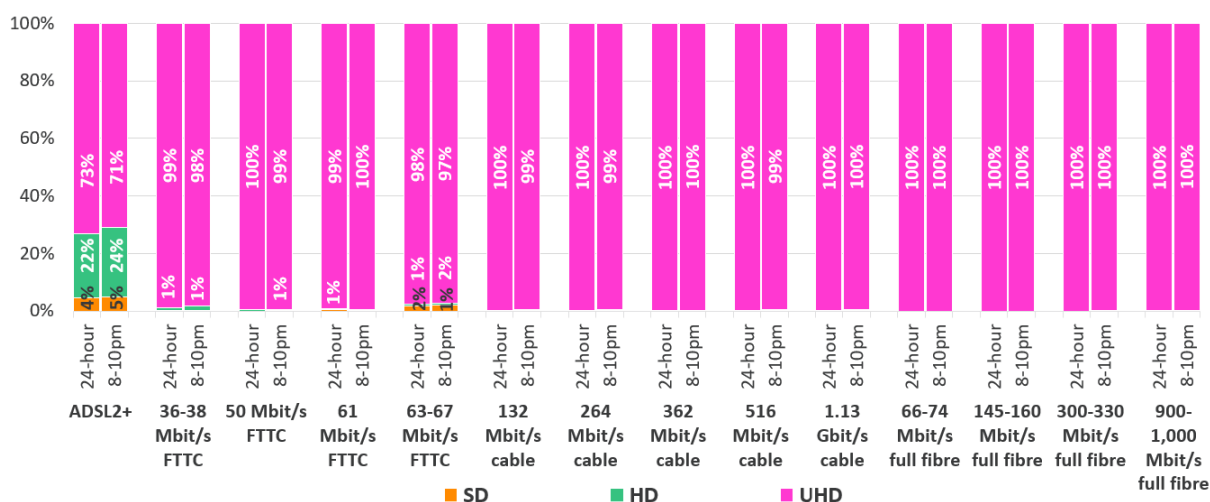
Most broadband connections enable reliable streaming of Netflix content in ultra-high definition

Streaming video content is one of the most bandwidth heavy activities that people use their home broadband connections for, and our [Media Nations 2023 report](#) found that 66% of homes used a subscription video-on-demand (SVoD) service in Q1 2023 with a similar proportion using broadcasters' video-on-demand services such as BBC iPlayer and ITVX. We measured the performance of broadband connections when streaming content from Netflix, the UK's most popular SVoD service, which was used by 59% of UK homes in Q1 2023.

Figure 10 below shows the proportion of Netflix video streams that could be reliably delivered in the most commonly available resolutions – ultra-high definition (UHD), high definition (HD) and standard definition (SD) – for each connection type. These proportions are based on when one piece of content is being streamed from Netflix over a broadband connection: the streaming user-experience may diminish when multiple people are streaming content over the same broadband connection at the same time. While all Netflix customers can stream HD content, UHD resolution is only available to people subscribing to Netflix's Premium plan and not all content is available in higher resolutions. Our Netflix streaming tests are run in such a way that these limitations do not impact the results (and all tests can record a successful UHD stream result if the connection is sufficient to support one).

Over the 24-hour period, 73% of Netflix videos on ADSL2+ connections were reliably delivered at UHD resolution in March 2023, up from 69% in March 2022. Twenty-two per cent of Netflix videos over ADSL2+ connections were reliably delivered in HD, with a further 4% in SD. ADSL2+ connections may therefore be sufficient to satisfy the current broadband needs of smaller households. Netflix content was reliably streamed in UHD on nearly all superfast fibre and cable connections (those with an advertised speed of at least 30 Mbit/s), both over the peak-time and 24-hour period.

Figure 10: Proportion of Netflix videos reliably delivered at the given video quality, over 24 hours and at peak times, by technology: March 2023



Source: Ofcom, using data provided by SamKnows; see note [H] in the [Sources Annex](#).

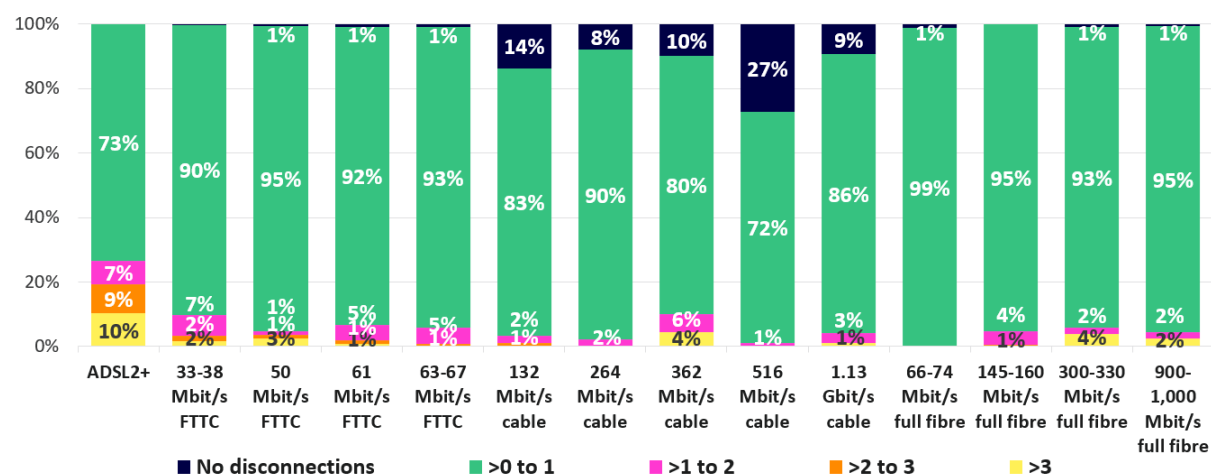
More frequent disconnections on ADSL2+ than other technologies

To look at how often disconnections occur on broadband services, we analysed the average daily number of disconnections of 30 seconds or longer. However, not all the disconnections recorded in Figure 11 are caused by network issues: for example, a panellist restarting their router or network maintenance or upgrades undertaken by broadband providers during quiet hours would be observed as disconnections by our tests.

In March 2023, 516 Mbit/s cable connections had the highest proportion of lines without any disconnections of 30 seconds or longer out of the package types included in our analysis (27%). ADSL2+ panellists typically experienced disconnections more often than cable or fibre panellists and had the highest proportion of lines with an average of more than two daily disconnections of 30 seconds or longer in March 2023 (at 19%, more than double the 9% recorded in March 2022). This was also more than four times higher than any of the other connection types included in our analysis.

Some home broadband services offer cellular back-up, whereby the router switches to a mobile connection if the fixed broadband network is unavailable. In the event of a disconnection, there would be little or no interruption for users who have a home broadband service that comes with a cellular back-up.

Figure 11: Distribution of average daily disconnections of 30 seconds or longer: March 2023



Source: Ofcom, using data provided by SamKnows; see note [1] in the [Sources Annex](#).

Note: In some cases, testing may record scheduled maintenance as being a disconnection event.

Broadband package comparisons

Introduction

In this section we look at average upload speeds, download speeds and latency for several popular superfast and ultrafast broadband packages.

As average speeds increase, connection speed has less influence on performance and other metrics such as latency (responsiveness) and packet loss (when data fails to reach its destination) become more important. The [interactive dashboard](#) that accompanies this technical report provides package comparison analysis over a wider range of metrics, along with tables that indicate whether any apparent differences in performance are statistically significant or not.

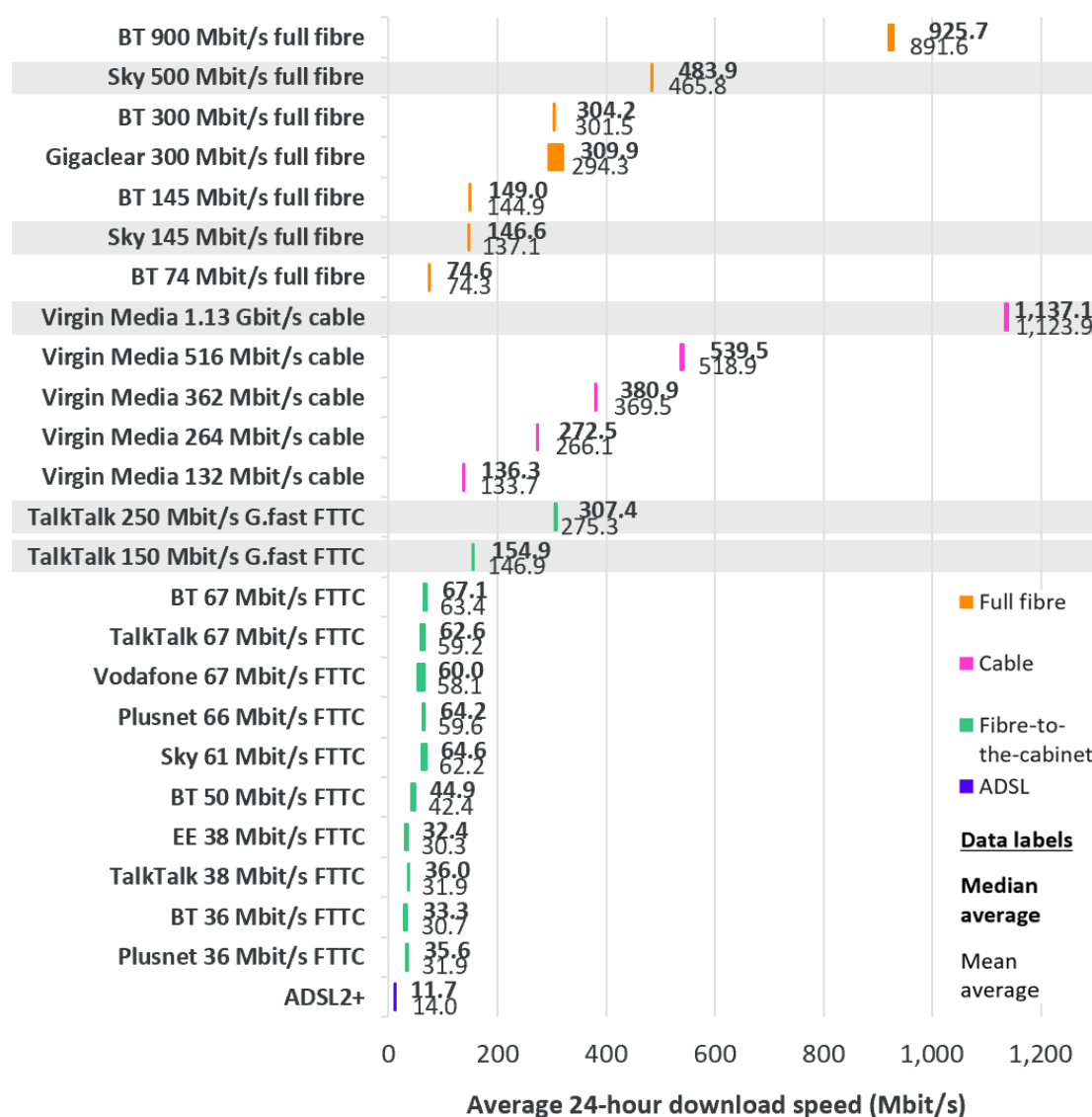
Virgin Media's 1.13 Gbit/s cable service recorded the highest average download speed of the packages included in our analysis

To compare performance among popular broadband packages, we have used both data from the SamKnows Whitebox panel and embedded test data collected from some broadband providers. Embedded test data was used to supplement data from the SamKnows Whitebox panel where there were insufficient panellists, or where the Whitebox measurements did not fully capture the performance of a package. Packages which are highlighted grey in the charts throughout this section are those where the data source is wholly taken from embedded test data collected by the broadband provider, as outlined on page 5 of this report. While these measurements are valid, caution should be exercised when comparing the performance of these packages to that of others.

The highest median and mean average 24-hour download speeds among the packages included in our March 2023 analysis was recorded by Virgin Media's 1.13 Gbit/s cable service, at 1,137.1 Mbit/s and 1,123.9 Mbit/s respectively. This shows that while half of Virgin Media's 1.13 Gbit/s cable users received a download speed of 1,137.1 Mbit/s (the median average) or more, the lower mean average shows that the distribution of speeds was skewed towards lower-speed lines, as was the case for all line types except ADSL2+ connections.

The 'Performance variation (ISP)' section of the [interactive dashboard](#) that accompanies this report explores consistency in download speed user-experience in greater detail.

Figure 12: Average 24-hour download speeds, by broadband package: March 2023 (Mbit/s)



Source: Ofcom, using data provided by SamKnows and ISP-provided embedded test data; see note [J] in the [Sources Annex](#).

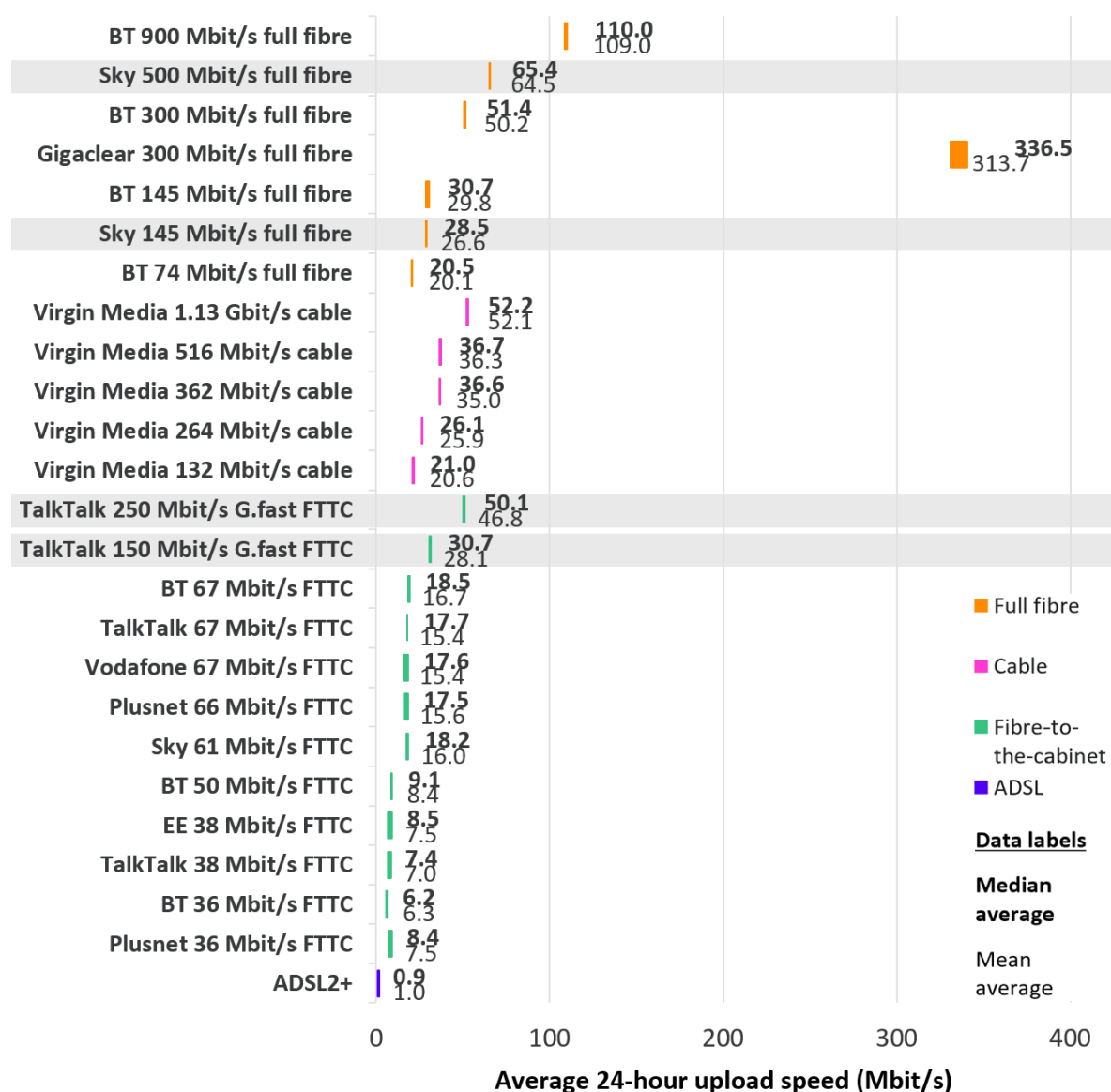
Notes: Many other broadband packages are available, some of which may match or better the performance of those included in the analysis above; the chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists in our sample) falls within the ranges shown; grey bars indicate that the data for a package has been wholly derived from provider embedded data, as outlined on page 5 of this report. While these measurements are valid, caution should be taken when comparing the performance of these connections to those of other packages.

The highest average upload speed was recorded by Gigaclear's 300 Mbit/s full-fibre service

Figure 13 below shows our finding that Gigaclear's 300 Mbit/s full-fibre service had the highest median and mean average upload speeds among the packages included in our analysis, at 336.5 Mbit/s and 313.7 Mbit/s respectively. This is a symmetrical service which offers the same advertised upload and download speeds.

On average, people with an ADSL2+ broadband connection who upgraded to a 36-38 Mbit/s FTTC service would benefit from an eight-fold increase in upload speeds, along with their download speed trebling.

Figure 13: Average 24-hour upload speeds, by broadband package: March 2023 (Mbit/s)



Source: Ofcom, using data provided by SamKnows and ISP-provided embedded test data; see note [J] in the [Sources Annex](#).

Notes: Many other broadband packages are available, some of which may match or better the performance of those included in the analysis above; the chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists in our sample) falls within the ranges shown; grey bars indicate that the data for a package has been wholly derived from provider embedded data, as outlined on page 5 of this report. While these measurements are valid, caution should be taken when comparing the performance of these connections to those of other packages.

Full-fibre packages had the lowest connection delay

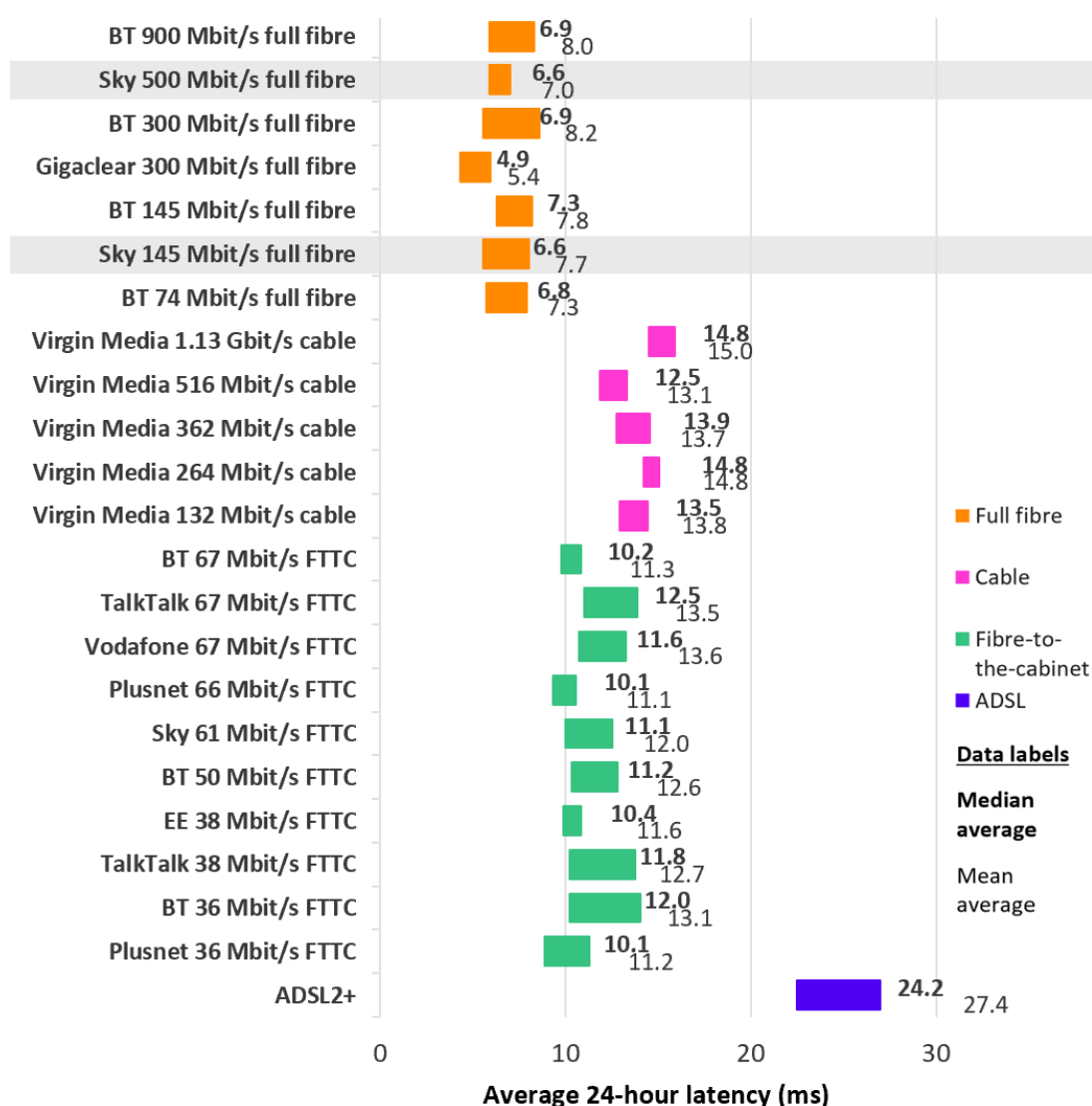
Latency (responsiveness) is the time it takes for a packet of data to travel to a third-party server and back. Low latency will make web browsing more responsive and greatly improve the

performance of some real-time activities such as video-calling and online gaming. Most online activities require a response time of less than 100ms to provide a good user-experience, while some online gaming apps require a response time of less than 50ms.

Full-fibre packages had the lowest median average 24-hour latency values of the packages analysed, recording latency values ranging from 4.9ms to 7.3ms. FTTC packages generally had slightly lower median average 24-hour latency values relative to cable, with FTTC's highest (worst) median latency (12.5ms for TalkTalk's 67 Mbit/s package) matching the lowest (best) cable latency recorded of the packages included (12.5ms for Virgin Media's 67 Mbit/s cable package).

The highest (worst) latency values recorded across the technologies tested were found in ADSL2+ connections, but these only averaged around 24ms, a level at which it was still unlikely to negatively affect the user experience for most use cases.

Figure 14: Average 24-hour latency, by broadband package: March 2023 (ms, lower is better)



Source: Ofcom, using data provided by SamKnows and ISP-provided embedded test data; see note [1] in the [Sources Annex](#).

Notes: Many other broadband packages are available, some of which may match or better the performance of those included in the analysis above; the chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists in our sample) falls within the

ranges shown; grey bars indicate that the data for a package has been wholly derived from provider embedded data, as outlined on page 5 of this report. While these measurements are valid, caution should be taken when comparing the performance of these connections to those of other packages.

Geographic comparisons

Introduction

For the second year running, we have requested ‘embedded’ test data from some broadband providers for our analysis. Broadband providers can run performance tests like those run by SamKnows’ Whitebox measurement units from their broadband routers. This allows broadband providers to monitor network performance and help ensure that accurate connection speed information is provided to customers buying broadband services under the [Residential Voluntary Codes of Practice on Better Broadband Speeds](#).

This section includes some of our initial analysis of ‘embedded’ test data provided to Ofcom by BT, Virgin Media, Sky and TalkTalk. Further analysis of this data can be found in the [interactive dashboard](#) that accompanies this technical report.

Notes on our analysis of performance variation across the UK nations and English regions

BT and Virgin Media have SamKnows tests embedded into some of their customers’ broadband routers, while Sky and TalkTalk run similar tests through another provider, ASSIA Inc., in some of their routers. We requested embedded test data from these broadband providers covering metrics of upload speed, download speed and latency test data and, across the four ISPs, analysed data from around 564,000 panellists with embedded testing activated. All data was anonymised, and no individual users could be identified.

The sample from each broadband provider included performance data relating to customers distributed across the UK and covered all services offered (although the samples were small for some packages). However, these samples are not designed to be representative of package take-up in each UK nation and English region and therefore it is not possible to draw conclusions regarding overall (average) performance in different parts of the UK. Having undertaken benchmarking of SamKnows and ASSIA test results against SamKnows’ Whitebox measurements, we found that while the results were broadly consistent and typically very similar (i.e. within a few per cent) there were some differences that mean that like-for-like ISP package comparisons are not possible at this stage.

We have used this embedded test data from broadband providers to look at how different broadband packages/package types perform across the UK nations and English regions. The limitations noted above, and the fact that we have analysed the data as received from the four broadband providers and have not weighted it to account for differing customer base sizes, mean that the analysis in this section is only indicative. Nonetheless, the analysis does allow us to draw conclusions regarding geographic performance variations.

We have looked at the performance of higher-speed services using the most frequently used broadband technologies in the UK:

- second-generation ADSL (ADSL2+) services;
- higher-tier (63-67 Mbit/s) VDSL-based FTTC services;
- 300-330 Mbit/s full-fibre services; and
- 1.13 Gbit/s cable services.

We used embedded test data recorded during the 8-10pm peak-time period, as not all the broadband providers we received embedded test data from run tests throughout the day. These results may differ from those highlighted elsewhere in the report, due to the reasons noted above, and the data being taken from a different source. Our results are calculated using test data collected from a minimum of 50 units for each package type in each UK nation/English region.

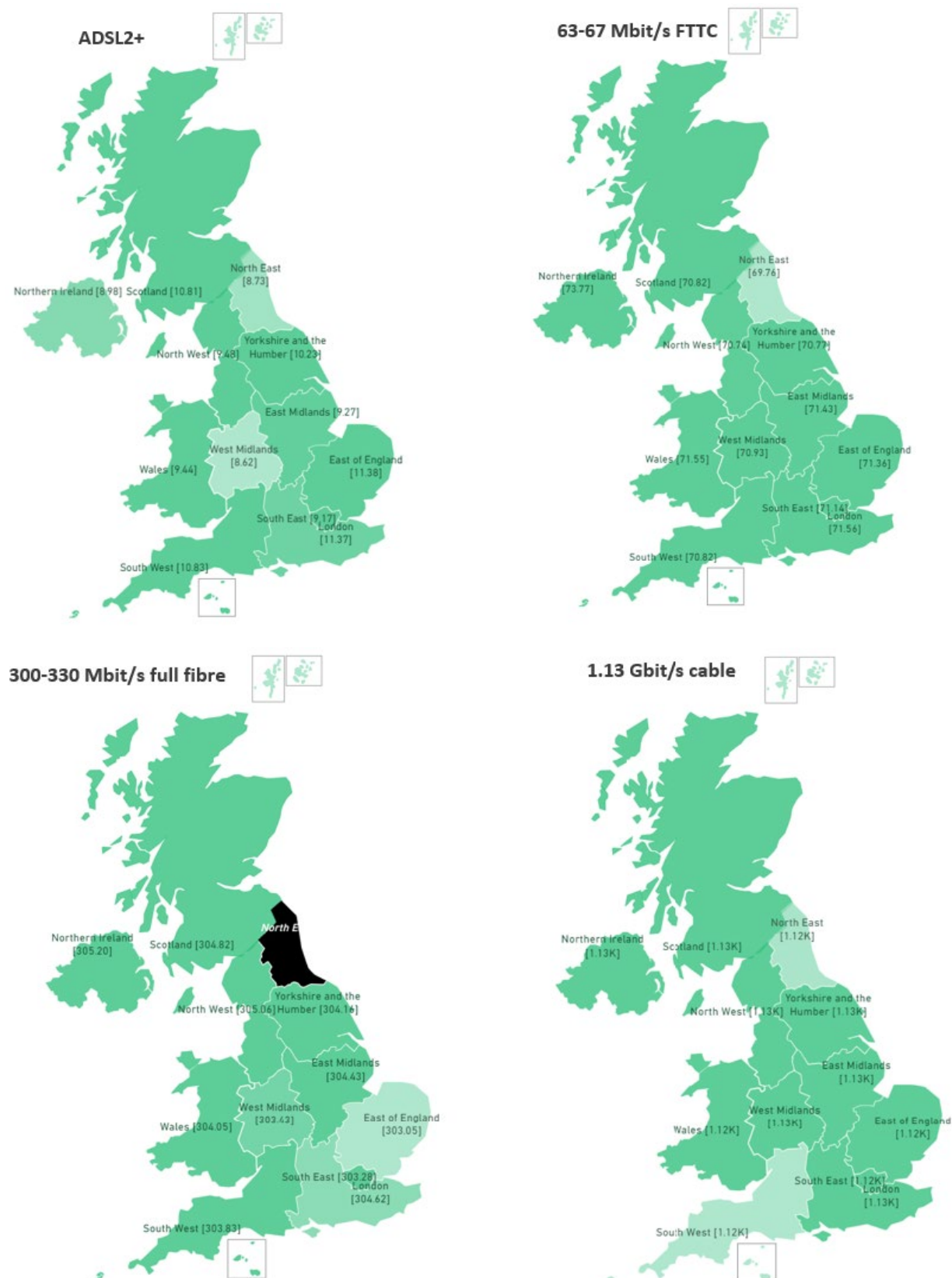
The [interactive dashboard](#) that accompanies this report covers the performance of other package types.

Regional variations were greatest for ADSL2+ services

Across the UK nations and English regions, median average peak-time download speeds for ADSL2+ broadband services ranged from 8.6 Mbit/s in the West Midlands to 11.4 Mbit/s in the East of England region. The 32% difference between the highest and lowest average download speeds recorded was larger than that found for 63-67 Mbit/s FTTC services, where there was a 6% difference between the 69.8 Mbit/s lowest recorded average peak-time download speed (in the North-East of England) and the 73.8 Mbit/s highest recorded speed (in Northern Ireland). The smaller variation in FTTC speeds is because of the copper line over which data travels is shorter in length than over ADSL connections.

Full-fibre services with advertised speeds of 300-330 Mbit/s recorded download speeds ranging from 303.1 Mbit/s in the East of England to 305.2 Mbit/s in Northern Ireland and had the smallest regional variation of less than 1%. For 1.13 Gbit/s cable services, average download speeds were lowest in the South-West of England at 1,116.7 Mbit/s and highest in London at 1,131.6 Mbit/s, a difference of just over 1%.

Figure 15: Average 8-10pm peak-time download speeds for selected package types, by UK nation and English region: March 2023 (Mbit/s)



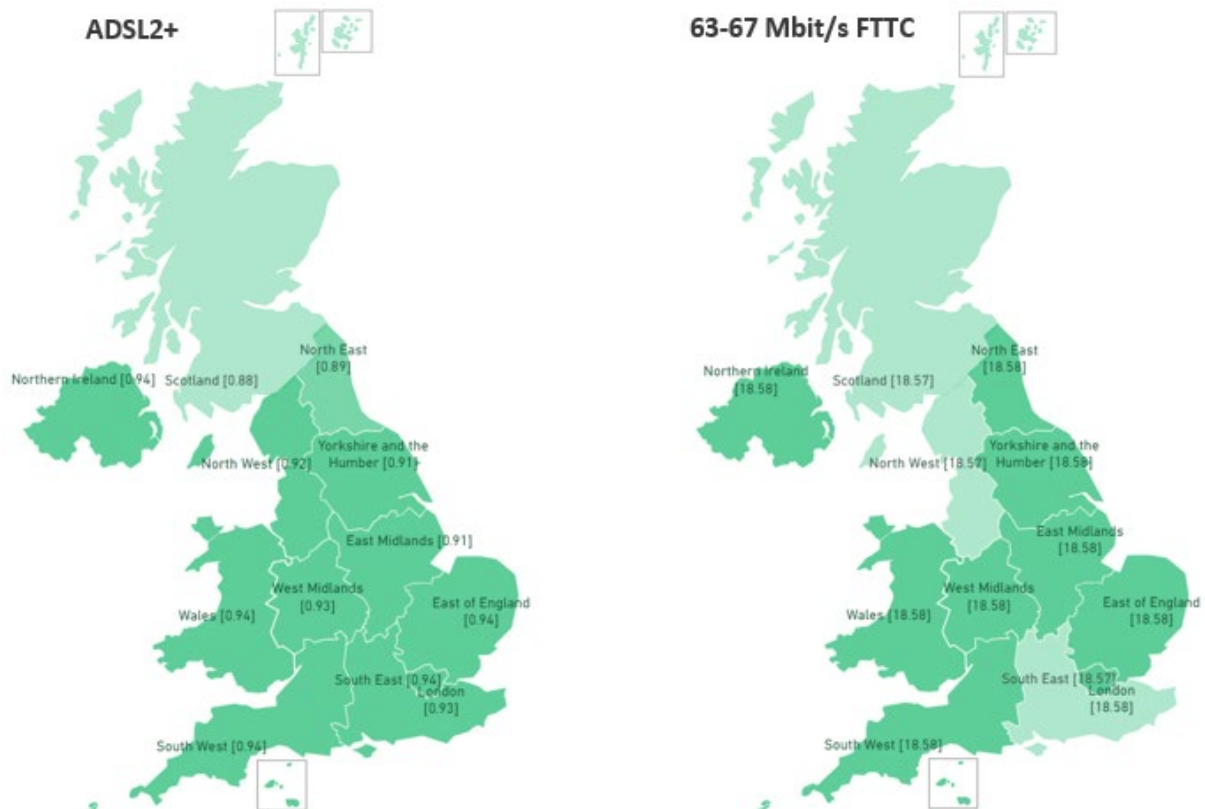
Source: Ofcom, using ISP-provided embedded test data.

Notes: Figures are indicative only; data not available for 300-330 Mbit/s full-fibre connections in the North East of England due to insufficient sample size.

The East of England had the highest average upload speeds for 300–330 Mbit/s full fibre services

Out of the four package types included in our analysis, 1.13 Gbit/s cable services recorded the highest 8-10pm peak-time upload speeds, ranging from 52.1 Mbit/s in London to 52.3 Mbit/s in the North-West of England. Average speeds for 300-330 Mbit/s full fibre services ranged from 50.5 Mbit/s in the North West of England to 51.6 Mbit/s in the East of England. For 63-67 Mbit/s FTTC connections, there was a difference of less than 1% between the lowest and highest recorded average 8-10pm upload speeds. ADSL2+ packages had upload speeds markedly lower relative to the other package types and the greatest regional variation between the lowest and highest recorded average 8-10pm upload speed (7%).

Figure 16: Average 8-10pm peak-time upload speeds for selected package types, by UK nation and English region: March 2023 (Mbit/s)



300-330 Mbit/s full fibre



1.13 Gbit/s cable



Source: Ofcom, using ISP-provided embedded test data

Notes: Figures are indicative only; data not available for 300-330 Mbit/s full-fibre connections in the North East of England due to insufficient sample size.